Appendix II-C

Analytical Approach and Methods

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The requirements in this appendix specify that the Columbia River Comprehensive Impact Assessment (CRCIA) analysis process is to be designed and technically conducted so as to objectively reveal probable adverse effects. Appendix II-A, in contrast, addressed the factors to be considered in the exposure process and determination of its impact. The analysis process performance needed is driven by the quality requirements for the assessment results specified in Appendix II-B. The analysis must effectively cut through the complexity of the exposure process and the consequent adverse effects to quantify the essential, or dominant, contributors to the impact. A comprehensive impact assessment can only be realized if the analysis process performs this function. Contaminants and effects are quantitatively related by modeling.

An overview of the requirements in this appendix is:

(C0.0-1) The analysis process design shall possess the capability to assess all impact, or threats of impact, listed in this document or discovered through the efforts of analysts and the CRCIA Board.

(C0.0-2) The analysis process shall identify, select, and organize the dominant sources of impact, and the dominant pathways and pathway characteristics from the sources to their adverse effects.

(C0.0-3) Models of the exposure process and consequent impact shall be validated.

(C0.0-4) The capacity to evaluate and respond to timeliness and quality tradeoffs shall be designed into the assessment process.

(C0.0-5) The assessment process shall manage uncertainty to achieve balanced uncertainty reduction as well as integration with management of dominant factors.

(C0.0-6) The architecture and integration features of the analysis process shall be specified prior to commitment of the major funding.

(C0.0-7) The assessment process shall incorporate a well defined data quality management process.

(C0.0-8) Assessment methods that are consistent with and integrate with other impact assessment requirements shall be adopted or developed and verified.

(C0.0-9) The assessment process shall manage verification.

(C0.0-10) Analysis research and development needs shall be identified.

(C0.0-11) Standards will be compiled especially for CRCIA as discussed in the General Requirements Section.

1.0 Identification and Management of Dominant Factors

The requirements in this section call for the assessment to always evaluate those factors having the greatest contribution to receptor exposure and consequent impact. A comprehensive assessment must describe the dominant effects and relationships involved. By focusing on dominant factors, simplified approximations can be used in models without compromising their validity. However, representing behavior in terms of dominant factors is a two-edged sword. The representation problem is intractable without limiting the representation to dominant factors. But, failing to include a major contributor distorts the answer, perhaps seriously. While less important factors must be excluded to conserve resources, all important factors must be included for validity. Failure to distinguish between important and unimportant factors is not acceptable. Distinguishing between the two is the subject of this section.

In model formulation an iterative search for dominant process features must be done. For example, in searching through the possible factors influencing an impact to identify the essential (dominant) set, indirect, as well as direct, effects must be considered. Dependencies among receptors may affect the dominant set. For example, a receptor of concern's dependency on other receptors may cause effects on them to be propagated to the receptor of concern. Relatively small effects on several receptors of no apparent interest may be cumulative in a receptor of interest. For example, predator/prey relationships in the food web may lead to substantial cumulative dose in a receptor of concern. If such chains of effects contribute significantly to the total impact, they must be carefully preserved in representing the progression of adverse effects. Impact may also be manifested through dynamic instabilities. For example, non-linear dynamics or positive feedback can cause sudden, unexpected population collapse in a threatened ecosystem.

By definition, a set of dominant factors accounts for the bulk of the related impact, to any required degree of completeness. Any set of factors that fails to account for the impact to the required degree of completeness is not a dominant set. The most influential factors must be included in the dominant set, both for effective simplification and to meet completeness requirements. Dominant factors can take the form of pathways, relationships, contributors to, or elements of, dose or effects.

An additional page of explicit, detailed requirements for this section has been identified from stakeholder concerns, issues, and experience. It does not appear in this draft due to insufficient time to develop an orderly presentation reasonably free of error or redundancy. It should be separately available by this draft's publication date for those who would like to request a copy. It will be included in the final document.

Conceptualization of the technical approach to the assessment must account for, if not begin with, the selection of methods and criteria with which to select the study set (dominant factors) from the candidate set (all-inclusive factors) in each module of the assessment process. For any given iteration of the assessment, all the assessment modules (see Figure C-1 below) will be included. However, the depth of detail will vary, that is, the number of factors making up the study set from each module will differ depending on their significance to the assessment end result. The study set selection methods must determine the depth of detail in each module such that a balance in significance is struck across all modules. This becomes a key in technical direction to each module's technical leader. It also becomes key in recommending budget allocations for the modules to the CRCIA management. It should be expected that the study set size and resource allocation for each module will have to be reviewed periodically as new information and modeling provide new insight to the significant contributors to the assessment final result. It is likely to be found that the study set selection methods involve an iterative series of sensitivity studies using first coarse, then progressively better approximations (models) of exposure and impact.

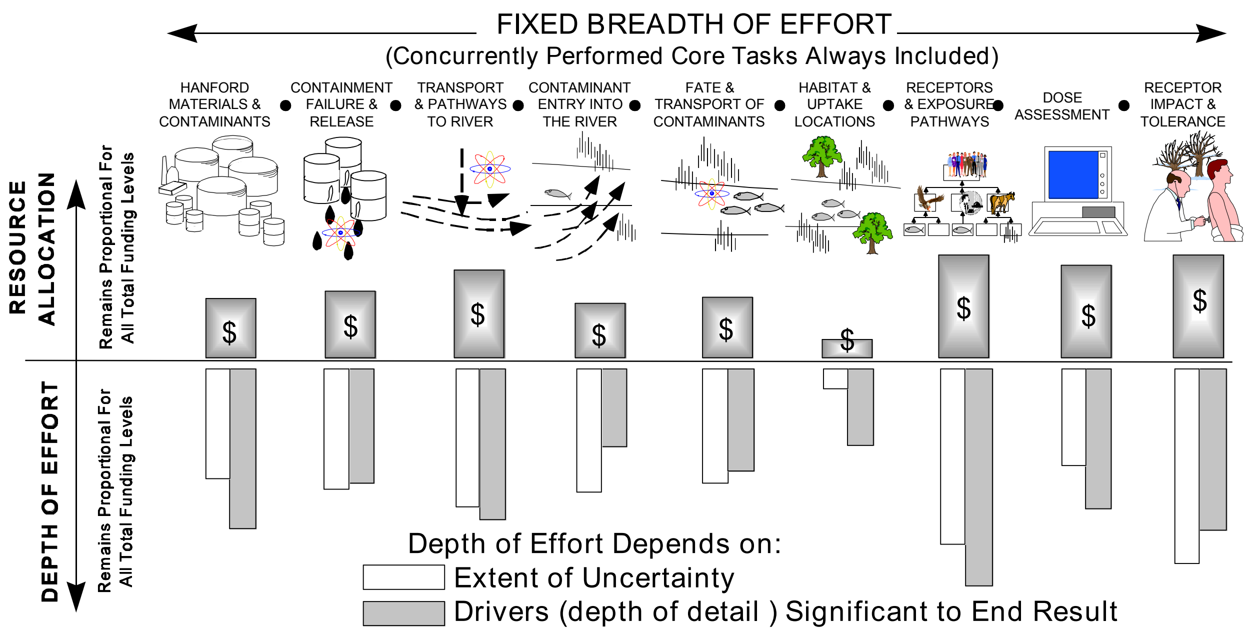

Figure C-1. Management of Dominance and Uncertainty

The sources of uncertainty and their extent of contribution to the overall uncertainty of the assessment's end result also vary across the nine assessment modules. To conceptualize the technical approach to the assessment, methods must also be selected to estimate the extent of uncertainty contribution. Because technical effort and resource allocation should be made such that overall uncertainty of results is reduced, it is necessary to reduce the uncertainty from the largest contributors. Figure C-1 depicts this relationship graphically. Further, uncertainty and dominance are coupled. For example, some given factor may be very uncertain but of little consequence to the assessment results. Therefore, the technical approach must include methods which can estimate these combined effects and balance the depth of effort across the modules such that both the most important factors and the degree of uncertainty receive appropriate resources and investigative efforts.

2.0 Identification and Management of Uncertainty

The requirements in this section call for uncertainties to be identified, quantified, and managed. An appropriate level of allowed uncertainty which considers both needs and costs is to be established through interaction by analysts and the CRCIA Board. The uncertainty, or probability distribution, of exposures and biological damage depends many factors. Examples include:

Scenario Uncertainty:
- (a) Climate (recharge rate) uncertainty
- (b) Socio-economic evolution
- (c) Ecosystem evolution

Performance Uncertainty:
- (a) Performance of the cleanup approach causing the exposure
- (b) Technological uncertainty—maturity of technology and application experience
- (c) Institutional performance uncertainty

Analysis Uncertainty:
- (a) Data/parameter uncertainty
- (b) Model uncertainty

Management involves reducing those uncertainties that reduce overall impact uncertainty the most for the available money. An iterative approach, starting from a coarse initial analysis and progressing through ever more refined analyses, with uncertainty reduction at each step, is normally used. Dominant uncertainties, uncertainties that are the largest contributors to overall impact uncertainty, are addressed. Irreducible uncertainty is reached when reducing the largest sources of uncertainty is beyond the available time and resources.

Note that dominance among uncertainties is closely related to dominance as discussed in the previous section and should be treated in a unified process using, for example, the methods in National Council on Radiation Protection and Measurements (NCRP) Commentary No. 14 (1996).

Two additional pages of explicit, detailed requirements for this section have been identified from stakeholder concerns, issues, and experience. They do not appear in this draft due to insufficient time to develop an orderly presentation reasonably free of error or redundancy. They should be separately available by this draft's publication date for those who would like to request a copy. They will be included in the final document.

3.0 Analytical Architecture and Integration

The requirements in this section call for the assessment process to have an architecture that:

(a) Supports iterative refinement of analysis products

(b) Uses resources well, performing up-front scoping analyses to ensure purposeful and efficient execution of main-line tasks

(c) Proceeds along a well-defined path to the final product

(d) Is well integrated, using pre-defined intermediate analytical products effectively

3.1 Functional Definition of the Analysis Process

The requirements in this section call for a complete functional definition of the assessment process to be done prior to assessment planning. They also call for major intermediate assessment products to be defined, and the functions needed to produce the products to be identified.

An additional half page of explicit, detailed requirements for this section has been identified from stakeholder concerns, issues, and experience. It does not appear in this draft due to insufficient time to develop an orderly presentation reasonably free of error or redundancy. It should be separately available by this draft’s publication date for those who would like to request a copy. It will be included in the final document.

3.2 Internal Interfaces of the Analysis Process

The requirements in this section call for the input information categories, intermediate products, and final assessment products to be well defined during design of the assessment process.

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4.0 Data Quality

The requirements in this section call for data quality, data gaps, data acquisition, and verification and validation to be managed in a balanced way and consistent with other requirements.

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5.0 Assessment Methods

The requirements in this section describe the characteristics the analysis methods and procedures used in the assessment must have.

(1) Assessment methods shall estimate the likelihood and severity of all the effects to be assessed.

(2) Assessment methods shall satisfy the quality requirements in Appendix II-B.

(3) Risk assessment methods shall be capable of detecting impact levels that affect the sustainability, robustness, and viability of the Columbia River ecosystem or stakeholder cultures.

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6.0 Verification

The requirements in this section call for the assessment process design to be properly verified before it is implemented.

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7.0 Analysis Research and Development Needs

The requirements in this section call for research and development needs for new or modified analytical methods to be promptly identified. They also call for research and development expenditures and efforts to focus on areas that make the most difference in assessment quality and assessment process performance.

Research to determine relative importance of factors which influence adverse effects will be an important part of identifying dominant assessment factors. The benefits of such research include assessment completeness and uncertainty reduction.

It is expected that, because of the delays and expense such development efforts entail, every effort will be made to incorporate the requirements for this assessment into previously planned and scheduled research efforts.

An additional half page of explicit, detailed requirements for this section has been identified from stakeholder concerns, issues, and experience. It does not appear in this draft due to insufficient time to develop an orderly presentation reasonably free of error or redundancy. It should be separately available by this draft's publication date for those who would like to request a copy. It will be included in the final document.

8.0   CRCIA Standards, Regulations, and Guidelines

The requirements in this section identify the standards to be used in the analytical process (see "Standards" in the section on Principles and General Requirements.)

(1) The applicability of federal, State of Washington and State of Oregon laws and guidelines shall be evaluated and reported to the CRCIA Board.

(2) Analysis methods shall be compatible with pertinent State of Washington and Oregon water regulations. Regulations such as Washington's Clean Water Act, Surface Drinking Water Act, and Model Toxins Control Act must be evaluated for applicability and relevance. The evaluation must be approved by the CRCIA Board.

(3) The most stringent applicable standards shall be identified and applied. For example, salmon related standards shall be applied in regions where salmon are affected. This means an analytical sensitivity below 11 parts per billion of chromium (the concentration at which injury to juvenile salmon occurs) in salmon reads shall be achieved rather than 50 parts per billion as required by the clean water (human) standard.